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the City of Providence,
Rhode Island.



THE DISPOSAL OF GARBAGE IN THE CITY OF PROVIDENCE, RHODE ISLAND.

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The swill or house garbage of Providence is collected and disposed of by contract. The present contract is for five years from May 1, 1889. The contractors receive $15\frac{1}{2}$ cents per annum for each inhabitant, and they are for this amount to collect and dispose of the garbage. At the present time the population of the city is estimated at 139,000, and they therefore receive \$21,545 per annum. When the contract was entered into, the contractors expected to dispose of the garbage by delivering it F. O. B. on the cars in the city to a hog-grower, who owned an extensive piggery some distance out in the country, and who had agreed to receive the garbage and pay the expense of transportation. The contract price therefore was estimated to give merely a small margin of profit over the cost of collecting alone, as the disposal was supposed to cost the contractors nothing. After the contract with the city was signed, the arrangement with the piggery people fell through, and the contractors were obliged to seek some other method of disposal. As a result a stock-company was formed and a process adopted for disposal by means of naphtha. Arrangements were made with I. M. Simonin, of Philadelphia, who had for many years been conducting the business of extracting grease and oil from various waste products by means of naphtha. Works were constructed near the center of the city in accordance with plans furnished by him. There is in Providence a large area of swampy land, recently filled in, almost in the center of the city. It was on this land, quite a distance from all buildings except two or three large manufactories, that the garbage works were established.

The use of naphtha for the extraction of fats and oils on a large scale is not a new art. It has been employed by a number of large firms in this country for many years. It was first applied to the utilization of garbage, I believe, by the Baynes Garbage Company, of Buffalo, New York, operating under the patents of the Merz Company of that city. By the Merz process the garbage is first dried as completely as possible in closed, steam-jacketed driers, the moisture being driven off, condensed, and discharged into the sewer or river. The dried garbage, or "tankage," as it is technically called, is then treated with hot, liquid

naphtha, which percolates through it and dissolves the grease. It is impossible to thus extract the grease unless the garbage has been thoroughly dried. The drying of the garbage by steam heat, which is necessary under the Merz patents, is an expensive operation. The Providence company at first experimented with the Anderson drier, which is constructed on an entirely different principle from the one used by the Merz people and is continuous in its operation and very economical. It failed, however, to dry the garbage, and hence was abandoned. Garbage contains so many different ingredients and so much grease that it is one of the most difficult substances to dry. The finer portions would come out of the Anderson drier in a very satisfactory condition, but larger masses, like potatoes and apples, were almost unaffected. It is necessary that the whole mass should be finely pulverized so as to become homogeneous and to be subjected to a high temperature for many hours in order to remove all the moisture.

Another experiment was tried by the Providence company for removing moisture. A press was set up, but it was soon discovered that the most powerful hydraulic pressure could not remove much more water than would drain from a pile of garbage in a few hours when merely left upon the floor or in a bin. The failure of the press was also due to the lack of homogeneity in the garbage. If it could be ground before pressing, much more liquid could be squeezed out; but grinding garbage is a very difficult operation and moreover would complicate the process too much. Thus from repeated trials it was found that from an economic as well as from a sanitary standpoint, pressing and drying garbage in the ordinary way were impracticable.

By the process finally adopted and now in operation, the garbage is dried and the grease removed at one and the same time, by treating it in a closed receptacle to the action of hot naphtha and naphtha vapor.

In Providence the owners or occupants are required to dispose of ashes and all other refuse, except garbage, at their own expense. The garbage, separated from everything else, is kept in tubs or barrels in the yard and is called for by the contractors three times a week during the summer and twice a week during the winter, and oftener in special cases when required by the health officer. The separation of garbage in this way is very thoroughly carried out, and it is only exceptionally that it is mixed with ashes. The contractors use for the collection 16 two-horse carts. These carts are constructed of wood, are water-tight, with covers, and are of the following dimensions: width, 3 ft. 8 in., length, 11 ft. 5 in., depth, 2 ft. 6 in., and weigh about 3,300 pounds. The weight of a wagon-load of garbage is on an average about two tons. A considerable portion of this weight is due to water, and when the garbage has been left to drain for a few hours it is found to diminish about 50 per cent. in weight though it does not diminish very much in bulk. The garbage, immediately after its collection, is carried to the disposal works previously referred to, near the center of the city, which are operated by Mr. I. M. Simonin, to whom the contractors deliver the garbage.

The garbage is here unloaded upon a concrete floor, where it is allowed to drain of superfluous water, which runs into a river that flows close by. The amount of the liquid is of course in the aggregate not very large, and could be without offense discharged into a small stream or a well-constructed sewer. After it has been allowed to stand here for a few hours, it is loaded into carriages which are at once rolled into the extractors. The carriages carry a series of trays made of sheet-iron and coarse wire netting, so that the garbage is spread in layers about six inches in thickness. This is to prevent the matting together of the garbage, which would result from the pressure of its own weight if it were loaded into the extractor in bulk. The carriages with their trays are made of such a form that they fill the extractors as completely as possible, so that the naphtha will be forced to pass through the interstices of the garbage rather than around the sides of the mass. The extractors are wrought-iron tanks six feet in diameter and eighteen feet long, and calculated to stand a considerable internal pressure. The extractors are placed horizontally, and one head is removable, being lifted off by a tackle from above, and made tight when in place by screw-bolts around the rim. When loaded, an extractor contains about eight tons of garbage as it comes from the floor. The head of the extractor is then screwed on and the extractor pumped full of hot naphtha. In the bottom of the extractor is a closed coil of steam pipe. The steam is now turned into this and the naphtha vaporized. The hot naphtha vapor as it passes up through the garbage takes up the water vapor, just as hot air would do under the same circumstances. The mixed naphtha and water vapor is led off from the top of the extractor to a condenser formed by a coil of pipe over which cold water is kept flowing. The condensed water and naphtha pass to the "separator," where they separate in two layers, the naphtha floating on top. The naphtha is drawn off continuously to the naphtha tanks and the water passes off into the river, or could well be discharged into the sewer if there was one. From the naphtha tanks the naphtha is pumped directly to the extractors again, passing through a heater on its way. This heater is so arranged as to heat the cold naphtha by means of the hot naphtha vapor which comes from the extractors, thus forming a sort of secondary condenser and economising both the heating of the naphtha and the cooling of the naphtha vapor. As the naphtha in the extractor is brought in contact with the garbage it dissolves out some of the grease. The naphtha vapor also, as it passes through the garbage, dissolves out the grease, which trickles down into the liquid beneath. As the evaporation continues, the level of the liquid in the extractor sinks lower and lower. It is a solution of grease and naphtha, which is constantly becoming more and more concentrated. When it is evaporated so that there is only a small amount in the bottom of the extractor, not reaching the level of the bottom of the carriages containing the garbage, it is forced off into the "settler." The extractor is then filled with naphtha again and the process repeated seven or eight times, until all the grease and water are removed. Open steam is then

turned into the extractor and allowed to pass through the garbage for three or four hours, until every vestige of the naphtha is removed. This steam also, after leaving the extractor, passes through the condenser, so that every portion of naphtha that it removes from the garbage is saved. The evaporation of a charge of naphtha occupies about four hours, open steaming about the same, so that the whole time occupied in extracting the garbage is thirty-two to thirty-six hours. After the open steaming, the head of the extractor is removed and the charge drawn out and carried to another building, where the dried garbage is ground, sifted, and bagged, ready to ship to fertilizer manufacturers. The amount of dried garbage, or tankage, which is obtained from an extractor varies somewhat at different seasons of the year, but averages about a ton and a half. To return to the settler: this is a tall, upright, iron tank which receives the solution of grease and naphtha from the extractors and also a certain amount of water and dirt which comes with it. This latter is drawn out from the bottom and passes into the river, while the naphtha solution goes into the stills where the naphtha is driven off by distillation and open steaming, and the grease is then drawn off and is ready for shipment. The amount of grease also varies with the seasons, but will average about six hundred pounds to an extractor.

The works in Providence consist of a building in which are three boilers aggregating about 235 horse-power; here is also the engine and the grinding mill and the store-room for the tankage. Attached to this building is a shed where the garbage is unloaded from the teams and put on the carriages. The building where the naphtha process is conducted is entirely separate from this building, and is merely a frame covered with corrugated iron. In it are six extractors, two settlers, two stills, and the necessary pumps, tanks, and piping. The condensing apparatus is outside, in order to get the advantage of cold air. The water for condensing is supplied by a large steam-pump, which is connected with four driven wells supplying about 250,000 gallons every twenty-four hours, at a temperature of 50 degrees, which is uniform throughout the year. The tanks for storing the naphtha are also in the open air. The works are run day and night with the exception of Sunday. The quantity of coal consumed is about forty-eight tons per week, or a little over two tons for each extractor full of garbage treated; therefore one ton of coal evaporates about three tons of water. There is a loss of naphtha in various ways, by leakage and evaporation, amounting to nearly 1,000 gallons a week.

The amount, value, and composition of garbage varies very greatly at different seasons of the year. The bulk is the largest in the summer, beginning to increase with the beginning of pea-pod time and reaching its maximum during the height of the green-corn season, at which time the total volume of the garbage is fifty per cent. greater than it is at the minimum. The smallest quantity is in spring and fall. Vegetable material in garbage has little value as a fertilizer or for grease. In the winter time the bulk and weight of the garbage is, in the climate of Prov-

idence, increased considerably by snow and ice. The amount of garbage collected during the year is about 15,000 tons as it stands in the carts. As has been stated, about fifty per cent. of this drains out on the floor. Of the remainder, from seventy-five to eighty per cent. is water, from three to six per cent. grease, and the remainder—from fourteen to twenty-two per cent.—dry residue or tankage. The grease is very dark in color and can be used for any purpose for which dark grease is adapted. The tankage shows on analysis from five to twenty per cent. bone phosphate, from three to six per cent. ammonia, and a little over one per cent. potash. It is exceedingly dry, and is in great demand by fertilizer manufacturers for mixing with other ingredients.

There has been considerable complaint in regard to the nuisance caused by the works for the disposal of garbage just described. A part of this undoubtedly has some foundation in fact. The garbage as it drains upon the floor is undoubtedly a nuisance, though the smell from this is somewhat confined by the building and does not travel very far. In the construction of new works pockets would be provided similar to those used for grain or coal, in which the garbage would be at once received and tightly covered. If necessary these pockets could be ventilated under the fires. The other source of nuisance is from the leakage of naphtha vapor. As the naphtha is used over and over again it becomes saturated with odors derived from the garbage, and being very volatile, whenever a leak occurs the vapor is carried to a considerable distance. This source of nuisance I think could also be removed by having a different kind of condenser which would not leak.

